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[There are no amendments to this patent.]

Abstract

Objective

The objective of the present invention is to provide a nonwoven fabric having sufficient stretchability in the transverse direction and having high stretchability under low stress and its manufacturing method.

Constitution

The highly stretchable nonwoven fabric is made of a spun-bonded nonwoven fabric that consists of an eccentric core-shell type composite fiber comprising a core component made of (a) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate in the range of 5 to 20 g/10 min and a shell component made of (b) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a) by at least 9 to 20 g/10 min, and having stretchability in the transverse direction of at least 400%.

Claims

1. A highly stretchable nonwoven fabric characterized by the fact that the highly stretchable nonwoven fabric is made of a spun-bonded nonwoven fabric consists of an eccentric core-shell type composite fiber comprising a core component made of (a) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate in the range of 5 to 20 g/10 min and a shell component made of (b) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a) by at least 9 to 20 g/10 min, and having stretchability in the transverse direction of at least 400%.

2. A method of manufacturing a highly stretchable nonwoven fabric characterized by the fact that heat is applied to a spun-bonded nonwoven fabric that consists of an eccentric core-shell type composite fiber comprising a core component made of (a) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and melt flow rate in the range of 5 to 20 g/10 min and a shell component made of (b) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a) by at least 9 to 20 g/10 min to a temperature of 10 to 40°C below the melting point of the aforementioned propylene type polymer (b) followed by stretching to 1.2 to 1.6 times in the machine direction in a first stage; then, stretching in a second stage to 1.3 to 3.0 times the length of the nonwoven fabric stretched in the first stage while maintaining the heating value of the stretched nonwoven fabric.

3. The method of manufacturing a highly stretchable nonwoven fabric described in Claim 2 in which the size of the fiber of the aforementioned core-shell type composite fiber is 3 d or less, and the metsuke of the aforementioned spun-bonded nonwoven fabric is 30 g/m$^2$ or less.

<u>Detailed explanation of the invention</u>

[0001]

Technical field of the invention

The present invention pertains to a highly stretchable nonwoven fabric and its manufacturing method, and the invention further pertains to a nonwoven fabric having high stretchability in the transverse direction and its manufacturing method.

[0002]

Technical background of the invention

In the past, nonwoven fabrics with stretchability have been used as the backing for medical and sanitary products, packaging materials, etc., for example, cataplasms and disposable diapers.

[0003]

In general, a composite material comprising an elastic material such as an elastic cord that provides stretchability in the waist area and in the crotch area and a nonwoven fabric having a cloth-like feel is used for disposable diapers. Historically, in manufacturing the above-mentioned materials, methods have been used in which an elastic cord, etc. is woven through a nonwoven fabric to form a composite material, or a nonwoven fabric is bonded with a stretched material to form a composite as described in Japanese Kokoku Patent No. Sho 62[1987]-28456, etc., but fabrication is complicated in these methods, and the elastic cord or

elastic material is used in the shrunken state, thus, the nonwoven fabric used in combination forms pleats and is likely to irritate the skin of an infant. The aforementioned problem occurs when the stretchability of the nonwoven fabric used in combination is insufficient.

[0004]

An effort has been made to provide stretchability to the nonwoven fabric as well. As a method used for providing stretchability to the nonwoven fabric, WO 94-23108 describes the application of heat to a nonwoven fabric made of a synthetic resin to raise it to a temperature below the melting point but above the softening point of the resin, but production of a nonwoven fabric with sufficient stretchability is not possible with this method.

[0005]

Objective of the invention

The present invention is based on the above-mentioned prior art and the purpose of the present invention is to provide a nonwoven fabric having sufficient stretchability in the transverse direction and high stretchability under low stress and a method for its manufacture.

[0006]

Outline of the invention

The highly stretchable nonwoven fabric of concern in the present invention is characterized by the fact that it is made of a spun-bonded nonwoven fabric that consists of an eccentric core-shell type composite fiber comprising a core component made of (a) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and melt flow rate in the range of 5 to 20 g/10 min and a shell component made of (b) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a) by at least 9 to 20 g/10 min, and having a stretchability in the transverse direction of at least 400%.

[0007]

A method of manufacturing the highly stretchable nonwoven fabric of concern in the present invention is characterized by the fact that heat is applied to a spun-bonded nonwoven fabric that consists of an eccentric core-shell type composite fiber comprising a core component made of (a) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate in the range of 5 to 20 g/10 min and a shell component made of (b) a propylene type polymer having an ethylene component content in the range of 0 to 5 mol% and a melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a)

by at least 9 to 20 g/10 min to a temperature of 10 to 40°C below the melting point of the aforementioned propylene type polymer (b) and stretching is provided to 1.2 to 1.6 times in the machine direction in a first stage, then, stretching is provided in a second stage to 1.3 to 3.0 times the length of the nonwoven fabric stretched in the first stage while maintaining the heating value of the stretched nonwoven fabric.

[0008]

In the present invention, it is desirable when the size of the aforementioned core-shell type composite fiber is 3 d or less, and the metsuke of the aforementioned spun-bonded nonwoven fabric is 30 g/m$^2$ or less.

[0009]

Specific explanation of the invention

In the following, the highly stretchable nonwoven fabric and the manufacturing method of the present invention are explained further in specific terms.

[0010]

The highly stretchable nonwoven fabric of concern in the present invention is made of a spun-bonded nonwoven fabric comprising an eccentric core-shell type composite fiber consisting of a core component made of a propylene type polymer (a) and shell component made of a propylene type polymer (b) having a melt flow rate greater than the melt flow rate of the aforementioned propylene type polymer (a).

[0011]

For the propylene type polymer (a) that comprises the composite fiber, a homopolymer of propylene having a melt flow rate (MFR: ASTM D1238, 230°C, 2.16 kg load, the same applies below) in the range of 5 to 20 g/10 min or a random copolymer of propylene and an α-olefin such as ethylene, 1-butene, 1-hexene, and 4-methyl-1-pentene can be used. Among those listed above, a propylene-ethylene random copolymer having an ethylene component content in the range of 0.5 to 5 mol% is further desirable from the standpoint of spinnability and softness of the resulting nonwoven fabric. Furthermore, it is desirable for the propylene type polymer (a) to have an Mw/Mn, which is an index of the molecular weight distribution, in the range of 2 to 4.

[0012]

For the propylene type polymer (b) that comprises the composite fiber, a homopolymer of propylene having a melt flow rate greater than the MFR of the aforementioned propylene type

polymer (a) by at least 9 to 20 g/10 min, preferably, at least 10 to 20 g/10 min, or a random copolymer of propylene and an α-olefin such as ethylene, 1-butene, 1-hexene, or 4-methyl-1-pentene can be used. Among those listed above, a propylene-ethylene random copolymer having ethylene component content in the range of 0.5 to 5 mol% is further desirable from the standpoint of spinnability and softness of the nonwoven fabric produced. Furthermore, it is desirable for the propylene type polymer (b) to have an Mw/Mn, which is an index of the molecular weight distribution, in the range of 2 to 4.

[0013]

The core-shell type composite fiber that forms the highly stretchable nonwoven fabric of the present invention has a weight composite ratio ((a)/(b)) of propylene type polymer (a) and propylene type polymer (b) in the range of 5/95 to 30/70, preferably, in the range of 10/90 to 25/75 and especially, in the range of 15/85 to 20/80.

[0014]

In the present invention, a slipping agent such as oleic acid amide or erucic acid amide may be added to the aforementioned propylene type polymer (b) at a ratio of 0.1 to 0.5 wt%. When a slipping agent is added to propylene type polymer (b), excellent flocking resistance can be provided to the highly stretchable nonwoven fabric produced. Furthermore, a slipping agent may be added to propylene type polymer (a) in the present invention as well.

[0015]

In the highly stretchable nonwoven fabric of concern in the present invention, the stretchability in the transverse direction is at least 400%, preferably, in the range of 400 to 600%, and especially, in the range of 450 to 550%. It should be noted that "machine direction" in the present invention means the direction in which the original nonwoven fabric is supplied to the machine, in other words, the flow direction of the original nonwoven, and "transverse direction" means the direction perpendicular to the direction of the nonwoven fabric supplied to the machine, in other words, the direction perpendicular to the flow direction of the original nonwoven.

[0016]

Furthermore, it is desirable for the highly stretchable nonwoven fabric of the present invention to have a tensile load at 100% stretching of 50% or less of the maximum tensile strength, preferably a low stress in the range of 5 to 20%. Furthermore, it is desirable for the highly stretchable nonwoven fabric to have low stretchability in the machine direction and a

specific degree of strength in order to retain processability, and the tensile load at 5% stretching of at least 250 g/25 mm is desirable and at least 500 g/25 mm is further desirable.

[0017]

In general, the metsuke of the highly stretchable nonwoven fabric is in the range of 15 to 50 g/m$^2$, and 15 to 30 g/m$^2$ is further desirable. The highly stretchable nonwoven fabric of the present invention can be used effectively for medical and sanitary products, packaging materials, etc., for example, cataplasms and disposable diapers. Furthermore, the highly stretchable nonwoven fabric may be laminated with a stretchable nonwoven fabric, etc.

[0018]

The aforementioned highly stretchable nonwoven fabric of the present invention can be produced when stretching is applied to a spun-bonded nonwoven fabric consisting of an eccentric core-shell type composite fiber in two or more stages. As a specific method used for production of the highly stretchable nonwoven fabric, for example, composite hot-melt spinning is done for a propylene type polymer (a) and a propylene type polymer (b) at a weight ratio of 5/95 to 20/80 to produce a composite long-fiber filament. The eccentricity of the spinning nozzle in this case is at least 0.5 mm, preferably, at least 0.1 mm. Subsequently, the spun filament is chilled with a cooling solution, and tension is applied to the filament with air to form the desired fiber size. Furthermore, the spun filament is collected on the belt, and heat embossing is applied to produce a spun-bonded nonwoven fabric. In general, the fiber size of the eccentric core-shell type composite fiber that forms the aforementioned spun-bonded nonwoven fabric is 3 d or less, preferably, 2 d or less.

[0019]

Manufacture of the highly stretchable nonwoven fabric is made possible when stretching is applied to the aforementioned spun-bonded nonwoven fabric in two stages or more under heat. As a specific method of manufacturing the highly stretchable nonwoven fabric, for example, first heat is applied to the fiber that forms the spun-bonded nonwoven fabric to raise it to a temperature of 10 to 40°C below, preferably, 10 to 25°C below, the melting point of the propylene type polymer (b), and stretching is done to 1.2 to 1.6 times, preferably, 1.4 to 1.6 times, in the machine direction. When the above-mentioned stretching ratio exceeds 1.6 times, crystallization of the resin that forms the fiber takes place and stretching in the stages that follow becomes difficult.

[0020]

Stretching is done through adjustment of the difference in speed of the feed roll and take-up roll. In order to increase the width shrinkage ratio, the stretching rate is adjusted to 2500%/min or less, preferably, 1500%/min or less. In general, the length of the stretching zone to achieve the final stretching ratio (distance between the feed roll and take-up roll used to provide the difference in speed at the time of stretching) in the first stage is at least 2.5 m, preferably, at least 5 m. In the aforementioned stretching treatment, an adjustment is made for the width shrinkage ratio to be at least 60%, preferably, 60 to 80%. Furthermore, heating of the spun-bonded nonwoven fabric is done in an oven, by an infrared heater, heated roll, hot plate heater, etc.

[0021]

Subsequently, the heating value of the stretched nonwoven fabric is maintained in the process that follows and stretching is done to 1.3 to 3.0 times, preferably, 1.5 to 2.5 times the length of the nonwoven fabric stretched in the first stage. The temperature of the nonwoven fabric in this case is 10 to 40°C below, preferably, 10 to 25°C below the melting point of the propylene type polymer (b).

[0022]

In order to increase the width shrinkage ratio, the stretching rate is adjusted to 2500%/min or less, preferably, 1500%/min or less. In general, the length of the stretching zone to achieve the final stretching ratio in the post stage is at least 2.5 m, preferably, at least 5 m. In the aforementioned stretching process, an adjustment is made to form a width shrinkage ratio of at least 60%, preferably, 60 to 80%. Furthermore, heating of the spun-bonded nonwoven fabric stretched in the first stage is done in an oven, by an infrared heater, heated roll, hot plate heater, etc.

[0023]

When the spun-bonded nonwoven fabric made of the above-mentioned eccentric core-shell type composite fiber is stretched in the machine direction at a specific ratio in two or more stages, production of a highly stretchable nonwoven fabric with a stretching ratio in the transverse direction of at least 400% can be produced.

[0024]

Effect of the invention

The method of manufacturing of the highly stretchable nonwoven fabric of concern in the present invention can be used to manufacture a nonwoven fabric having sufficient stretchability in the transverse direction and high elongation under low stress.

[0025]

Application examples

The present invention is explained in more detail with application examples below but the present invention is not limited to those application examples.

[0026]

It should be noted that the degree of elongation in the transverse direction was measured using an Instron tensile tester and a sample with 25 mm width x 200 mm length mounted at a chuck distance of 100 mm and under a pull speed of 300 mm/min and chart speed of 300 mm/min; the elongation at the time of maximum load was measured.

[0027]

Application Example 1

Polypropylene from Grand Polymer Co. (trade name: F-601, MFR: 6.5 g/10 min, melting point: 166°C, hereinafter referred to as "PP-1") and Polypropylene of Grand Polymer Co. (trade name: 5800, MFR: 15 g/10 min, melting point: 166°C, hereinafter referred to as "PP-2") were used and composite hot-melt spinning was done. An eccentric core-shell type composite fiber with the core component made of PP-1 and the shell component made of PP-2 (weight ratio of core component: shell component of 1:4) was deposited onto a collection screen to produce a spun-bonded nonwoven fabric (fiber size of the structural fiber: 3 d) with a metsuke of 20 g/m$^2$. The aforementioned spun-bonded nonwoven fabric was stretched at a temperature of 145°C to 1.5 times in the first stage using a hot plate heater as a heat source (first roll: 25 m/min, second roll: 37.5 m/min), and to 1.73 times at a temperature of 145°C in the latter stage using a hot plate heater as a heat source (third roll: 37.5 m/min, fourth roll: 65 m/min) to produce a nonwoven fabric stretched in the transverse direction. The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 400%.

[0028]

Application Example 2

A nonwoven fabric stretched in the transverse direction was made as in Application Example 1, where the stretching ratio of the latter stage in Application Example 1 was changed to 2.0 times (third roll: 37.5 m/min, fourth roll: 75 m/min). The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 500%.

[0029]

Application Example 3

A nonwoven fabric stretched in the transverse direction was made as in Application Example 1, where the stretching ratio of the latter stage in Application Example 1 was changed to 2.2 times (third roll: 37.5 m/min, fourth roll: 82.5 m/min). The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 550%.

[0030]

Application Example 4

A nonwoven fabric stretched in the transverse direction was made as in the case of Application Example 1, where the stretching ratio of the first stage in Application Example 1 was changed to 1.2 times (first roll: 25 m/min, second roll: 30 m/min), and the latter stage was changed to 2.75 times (third roll: 30 m/min, fourth roll: 82.5 m/min). The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 450%.

[0031]

Application Example 5

A nonwoven fabric stretched in the transverse direction was done as in Application Example 1, where the stretching ratio of the first stage in Application Example 1 was changed to 1.4 times (first roll: 25 m/min, second roll: 35 m/min), and the latter stage was changed to 2.36 times (third roll: 35 m/min, fourth roll: 82.5 m/min). The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 500%.

[0032]

Application Example 6

A nonwoven fabric stretched in the transverse direction was done as in Application Example 1, where the stretching ratio of the first stage in Application Example 1 was changed to 1.6 times (first roll: 25 m/min, second roll: 40 m/min), and the stage was changed to 2.06 times

(third roll: 40 m/min, fourth roll: 82.5 m/min). The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 500%.

[0033]

Comparative Example 1

The spun-bonded nonwoven fabric used in Application Example 1 was used in this case, and stretching was done to 2.0 times at a temperature of 140°C (first roll: 25 m/min, second roll: 50 m/min) using a hot plate heater as a heat source and a nonwoven fabric stretched in the transverse direction was produced. The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 290%.

[0034]

Comparative Example 2

A nonwoven fabric stretched in the transverse direction was done as in Comparative Example 1, where the heating temperature in Comparative Example 1 was changed to 145°C. The elongation of the aforementioned nonwoven fabric stretched in the transverse direction was 340%.

[0035]

Comparative Example 3

An attempt was made to produce a nonwoven fabric stretched in the transverse direction as in Comparative Example 1, where the stretching ratio in Comparative Example 1 was changed to 2.5 times (first roll: 25 m/min, second roll: 62.5 m/min). However, production was not possible due to rupturing.

[0036]

Comparative Example 4

An attempt was made to produce a nonwoven fabric stretched in the transverse direction as in the case of Application Example 1, where the stretching ratio of the initial stage in Application Example 1 was changed to 1.1 times (first roll: 25 m/min, second roll: 27.5 m/min), and the stretching ratio of the latter stage was changed to 3.0 times (third roll: 27.5 m/min, fourth roll: 65 m/min) (total stretching ratio: 3.3 times). However, production was not possible due to rupturing in the latter stage.

[0037]

<u>Comparative Example 5</u>

An attempt was made to produce a nonwoven fabric stretched in the transverse direction as in the case of Application Example 1, where the stretching ratio of the initial stage in Application Example 1 was changed to 1.7 times (first roll: 25 m/min, second roll: 42.5 m/min), and the stretching ratio of the latter stage was changed to 1.94 times (third roll: 42.5 m/min, fourth roll: 75 m/min) (total stretching ratio: 3.3 times). However, production was not possible due to rupturing in the latter stage.

[0038]

The results obtained above are shown in Table 1.

[0039]

Table 1

| | 1 実施例1 | 1 実施例2 | 1 実施例3 | 1 実施例4 | 実施例5 | 実施例6 | 2 比較例1 | 2 比較例2 | 2 比較例3 | 2 比較例4 | 2 比較例5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 延伸倍率(%) | 2.6 | 3.0 | 3.3 | 3.3 | 3.3 | 3.3 | 2.0 | 2.0 | 延伸切れ | 延伸切れ | 延伸切れ 4 |
| 5 初段の延伸倍率(倍) | 1.5 | 1.5 | 1.5 | 1.2 | 1.4 | 1.6 | — | — | — | 1.1 | 1.7 |
| 6 第1ロール/第2ロール (m/分) | 25/37.5 | 25/37.5 | 25/37.5 | 25/30 | 25/35 | 25/40 | 25/50 | 25/50 | 25/62.6 | 25/27.5 | 25/42.5 |
| 7 第3ロール/第4ロール (m/分) | 37.5/65 | 37.5/75 | 37.5/82.5 | 30/82.5 | 35/82.5 | 40/82.5 | — | — | — | 27.5/65 | 42.5/75 |
| 8 延伸温度(℃) | 145 | 145 | 145 | 145 | 145 | 145 | 140 | 145 | 145 | 145 | 145 |
| 9 横方向の延伸倍率(%) | 490 | 580 | 560 | 450 | 500 | 600 | 290 | 346 | — | — | — |

Key:
1 Application example
2 Comparative Example
3 Stretching ratio (%)
4 Rupture
5 Initial stage stretching ratio (times)
6 First roll/second roll (m/min)
7 Third roll/fourth roll (m/min)
8 Stretching temperature (°C)
9 Stretching ratio in transverse direction (%)

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